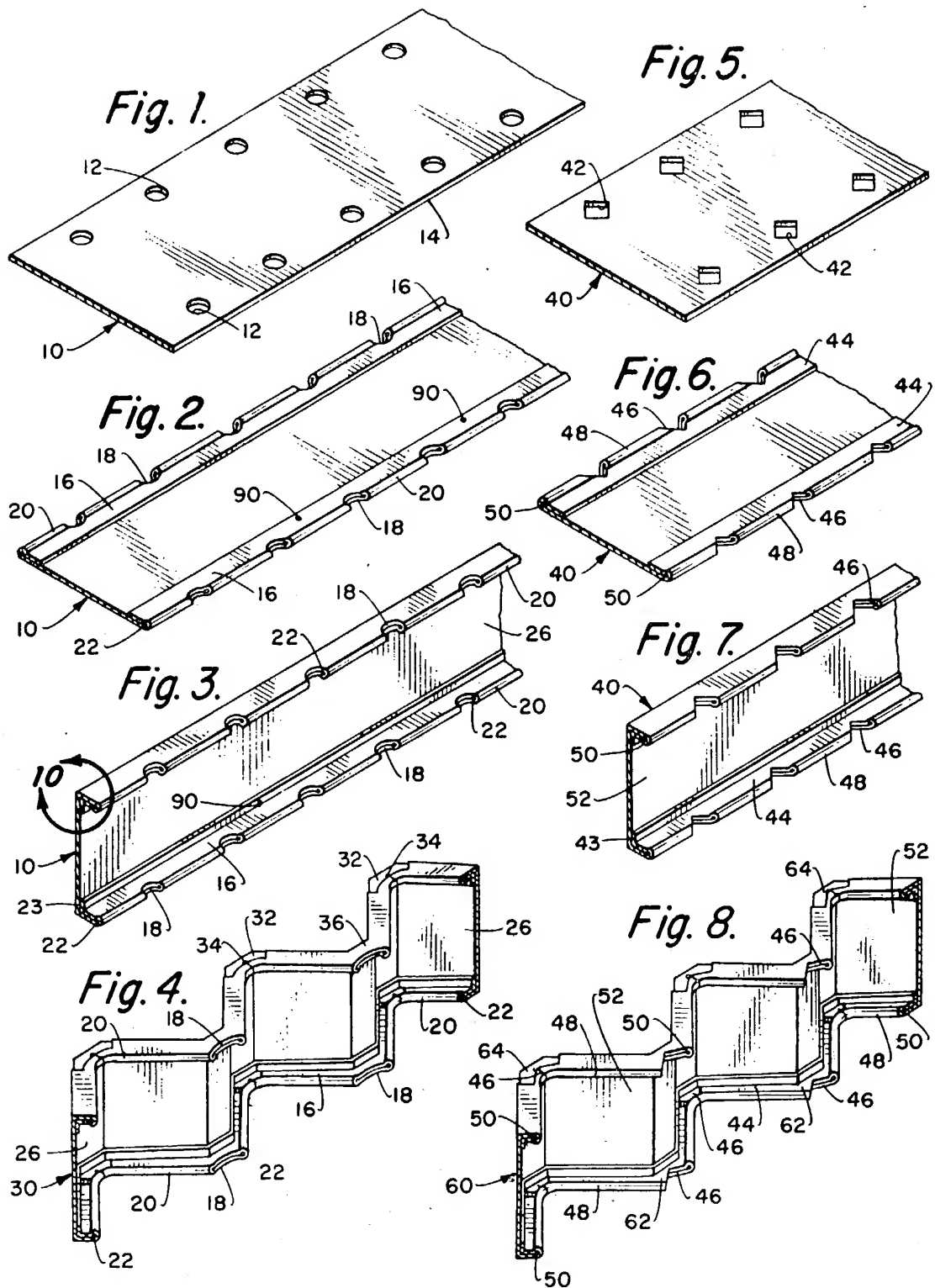
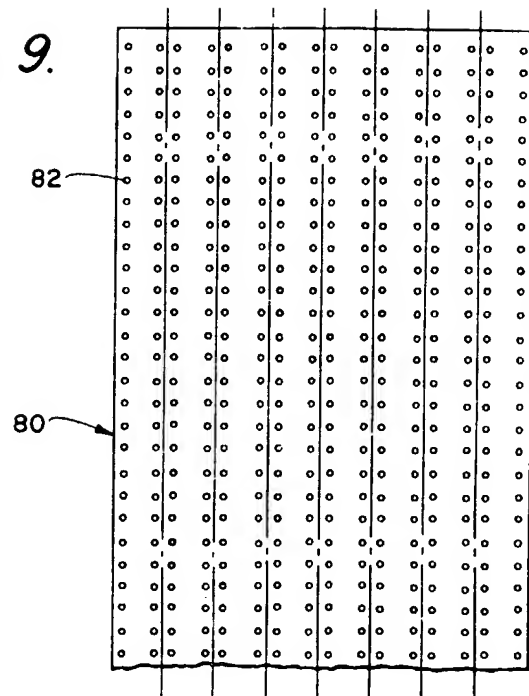
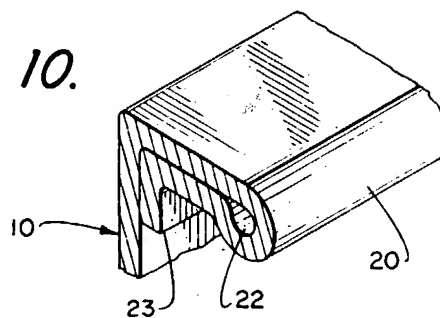
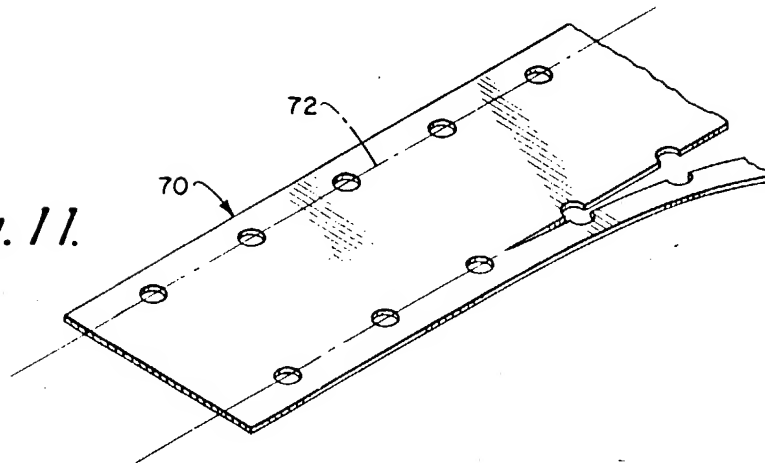


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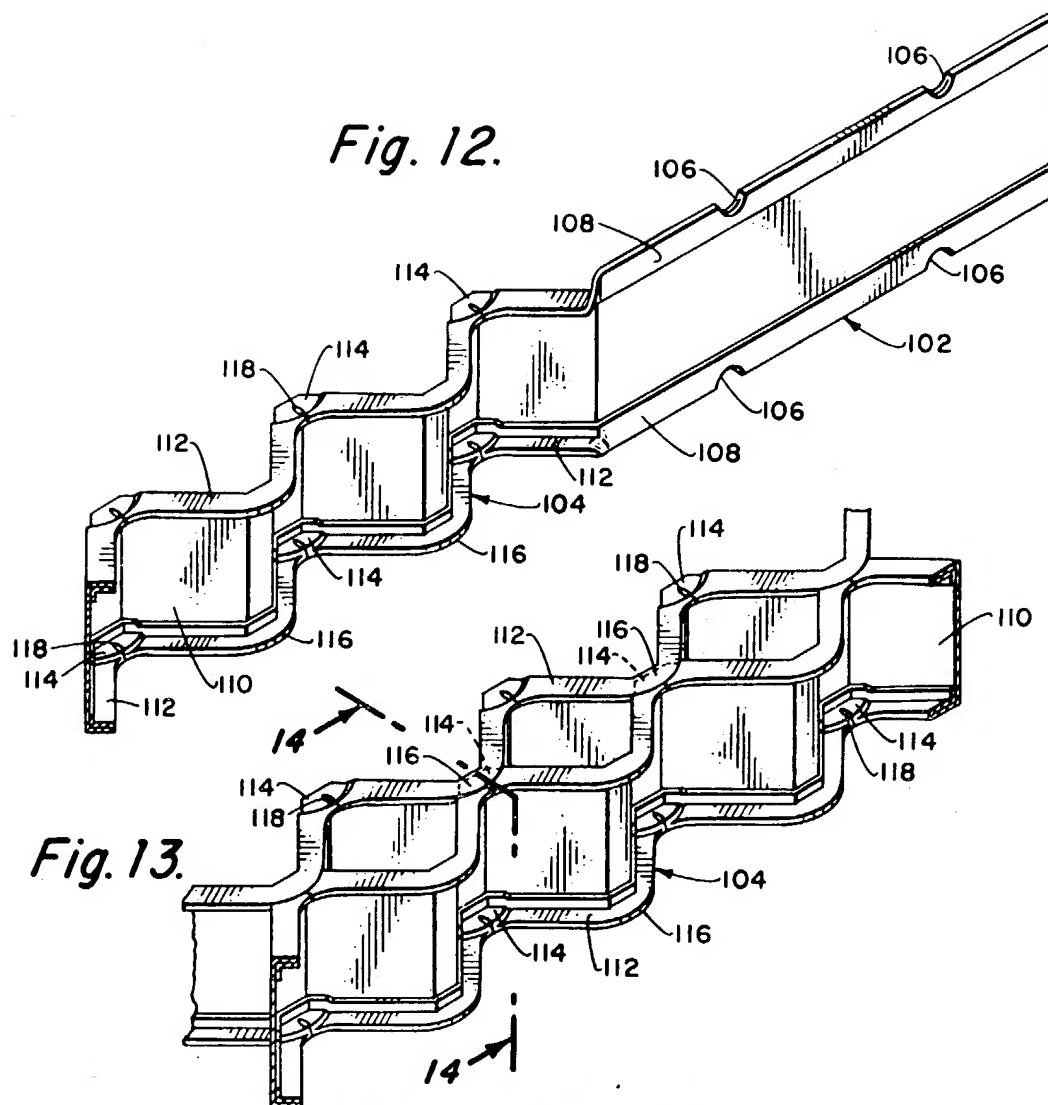
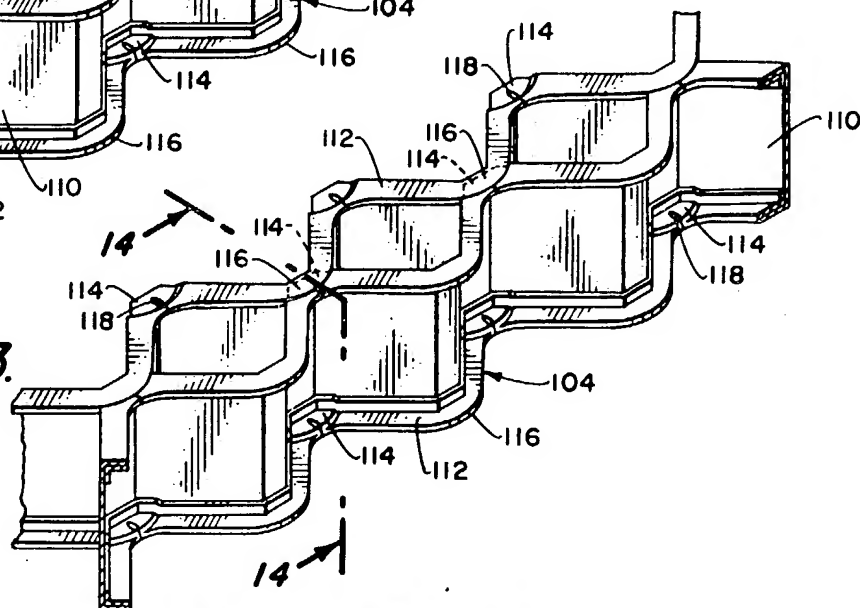
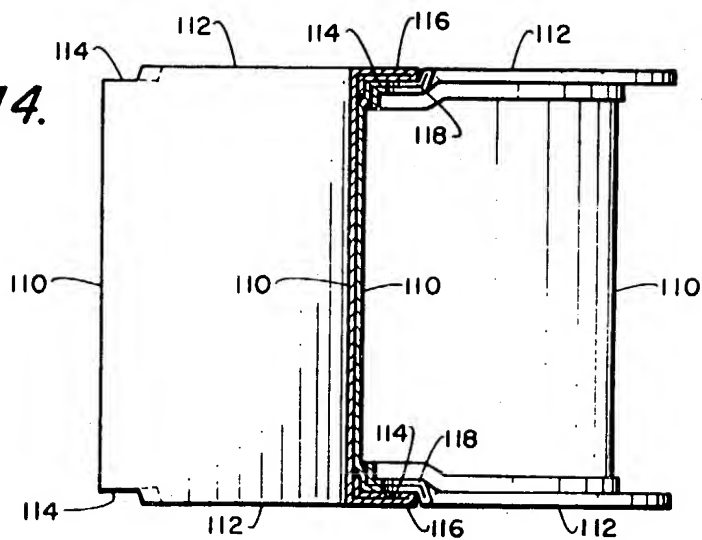
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Fig. 9.*Fig. 10.**Fig. 11.*

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Fig. 12.*Fig. 13.**Fig. 14.*

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at the opposite edges thereof.

4. A core strip blank as defined in Claim 3 in which the double layers of material are integral with each other.

5. A core strip blank as defined in Claim 3 in which each of said edges is provided with a series of notches.

6. A core strip blank as defined in Claim 3 in which the double layers of material at each edge of said blank are provided with a continuous series of notches whereby subsequent deformation of said blank is facilitated.

7. A core strip blank as claimed in claim 1 including an elongated body having opposite edges and said opposite edges having a continuous series of openings formed therein in parallelism with and spaced inwardly from said opposite edges.

8. A core strip blank as defined in Claim 7 in which said opposite edges are folded over to provide double layers of material at said edges, the lines of said folds being substantially central of said openings to reduce the size of said openings and provide a continuous series of notches on the opposite edges of said blank.

9. A core strip made from a blank as claimed in any preceding claim including an elongated body, said body having continuous flanges on the opposite edges thereof and an intermediate web defined by said flanges, said flanges having doublers thereupon to provide dual layers of material along the length of said flanges.

10. A core strip of the character defined in Claim 9 in which said doublers have portions overlying said web.

11. A core strip of the character of Claim 9 in which said doublers are provided with an arcuate bead at the extreme edge thereof.

12. A core strip of the character of Claim 10 in which said portions are positively secured in operative relationship with said web.

13. A core strip of the character of Claim 9 in which said doublers are positively secured in operative relationship with said flanges.

14. A core strip of the character of Claim 9 in which said doublers are provided with a continuous series of notches to facilitate the deformation of the same.

15. A core strip of the character of Claim 14 in which said core strip is deformed into corrugated configuration by alternately expanding and reducing said notches.

16. A method of fabricating a core strip from a ribbon of deformable material including the steps of: first folding the opposite edges of said ribbon to provide double layers of material at said opposite edges; and second folding said opposite edges in the region of the first fold to provide continuous flanges on said ribbon to constitute a core strip of channel-shaped configuration.

17. The method of Claim 16 in which the first folding step is preceded by a step entailing the formation of continuous series of openings

inwardly of and parallel to the opposite edges of said ribbon.

18. The method of Claim 16 in which said flanges are provided with a continuous series of notches subsequent to said second folding step to facilitate the deformation of said flanges.

19. The method of Claim 16 including forming a plurality of aligned openings in said strip adjacent the opposite edges thereof; reducing the size of said openings to provide outwardly opening notches penetrating the opposite edges of said strips; folding said edges of said strip at angles to the remainder of said strip; and deforming said strip to increase and reduce the dimensions, respectively, of alternate ones of said notches.

20. The method of Claim 19 wherein the reduction step is accomplished by folding over the edges of said strip.

21. The method of Claim 19 in which said reduction step is accomplished by cutting said edges of said strip in longitudinal paths across said openings.

22. The method of Claim 19 in which the deformation step includes the formation of said strip into corrugated configuration.

23. In a method of fabricating a core strip for utilization in conjunction with a plurality of identical strips to form a panel core, the steps of: punching a plurality of aligned openings parallel the opposite edges of a strip; reducing the area of said openings to provide aligned notches in the opposite edges of said strip; folding the opposite edges of said strip at angles to the remainder of said strip; and deforming said strip into a desired configuration.

24. The method of Claim 23 wherein the reduction step entails the preliminary folding of the edges of said strip into contact with the remainder of said strip.

25. The method of Claim 23 in which reduction step entails the cutting of such strip on lines across said openings.

26. The method of Claim 23 in which said deformation step includes the deformation of said strip into oppositely oriented ridges.

27. A core strip blank according to claim 1 or claim 3 substantially as herein described with reference to and as shown in Figures 1 to 4, or Figures 5 to 8 or Figures 9 and 10 or Figure 11 or Figures 12 to 14 of the accompanying drawings.

28. A core strip according to claim 9 substantially as herein described with reference to and as shown in Figures 1 to 4, or Figures 5 to 8 or Figures 9 and 10 or Figure 11 or Figures 12 to 14 of the accompanying drawings.

29. A method of fabricating a core strip according to claim 16 or claim 23 substantially as herein described with reference to and as shown in Figures 1 to 4 or Figures 5 to 8 or Figures 9 and 10 or Figure 11 or Figures 12 to 14 of the accompanying drawings.

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SPECIFICATION
Core Strip Blank, Core Strip and Method of Making Same

Those skilled in the art are aware of the
 5 manufacture of composite panels including a central core structure which is provided with face sheets on the opposite surfaces thereof. Such panels and core structures therefor are shown in Campbell previously issued U.S. Letters Patent
 10 Nos. 2,930,882; 3,015,715; 3,077,532; 3,598,953; 3,689,730; and Johnson Patent No. 2,983,038.

Campbell previously issued patents teach, among other concepts, the utilization of a core
 15 structure which consists of a plurality of internested core strips incorporating continuous flanges provided with male and female nodes adapted to internest with each other to provide a core of the desired area.

It is also known to provide core structures which include a plurality of core strips incorporating a series of tabs which are defined by a plurality of notches in the opposite edges of the core strip. Typical of the use of such notched
 25 core strip is the Johnson patent mentioned hereinabove.

Also known to those skilled in the art is the provision of panels of the Johnson-type wherein the apices of the corrugations of the core strips
 30 are notched to facilitate the deformation of the core strips into the corrugated configuration and the internesting of the core strips with one another. When such notched core strips are utilized, no attachment surfaces are provided at
 35 notched portions of the core strip for attachment to the inner surfaces of the juxtaposed face sheets of the panel. Consequently, the resistance of the resultant panel to flatwise tension is reduced by 15 to 20%.

The conventional process of forming core strip blanks initially entails the slitting of ribbons or strips of metal from relatively wide sheets of material. The slitting process results in the formation of minute cracks in the opposite edges
 40 of the resultant strip or ribbon and also causes the work hardening thereof which entails the necessity for an annealing process subsequent to the slitting of the blank.

However, even though the blank is annealed,
 50 micro-cracks remain in the opposite edges of the stainless steel materials utilized in the fabrication of the blanks, such as, Inco 718, 316, 347, 625, Rene 41, etc.

Consequently, when the blanks are subjected
 55 to the extreme deformation entailed by the internesting of the male and female nodes characteristic of the core structures of the aforementioned Campbell patents, the micro-cracks are greatly enlarged thus resulting in substantial reduction in the load bearing
 60 characteristics of the resultant core structure and possible cracking of the same when deformed in forming dies and/or subsequent handling.

Objects and Advantages of the Invention

65 Our invention contemplates the manufacture of core strip blanks from previously slit stock having edges incorporating various imperfections, such as micro-cracks, wherein the edges are folded over to provide doubled flanges or portions.

70 Consequently, when the folded over edges are subjected to the subsequent step of deforming them into continuous or discontinuous flanges on the opposite sides of the intermediate web to constitute a core strip, the imperfections
 75 previously alluded to are no longer disposed at the edges of the flanges but inboard of the edges of the flanges in juxtaposition to or overlying relationship with the webs of the resultant core strips.

80 Therefore, when the folded over flanges are subjected to the relatively massive deformation accompanying the formation of the male and female nodes entailed in the utilization of the teachings of the Campbell patents alluded to
 85 hereinabove, the edges of the flanges presented for such deformation are smooth and characterized by the complete absence of fissures or cracks which could lead to subsequent failure of the core strips or the core fabricated by the utilization thereof.

A major advantage of the utilization of the core strip blank of our invention to fabricate core strip of various configurations is the elimination of the annealing step referred to hereinabove since the work hardened edge of the ribbon or strip from which the blank is formed is disposed inwardly of the resultant core strip edge and, therefore, is inoperative to deleteriously affect the physical performance of the core strip.

100 In order to ensure maximum performance of blanks utilized in the prior art constructions as exemplified by the heretofore mentioned Campbell patents, the ribbons to be formed into core strips have been placed in a pickling solution after slitting in order to provide a radius on the opposite edges thereof and to eliminate therefrom, as much as possible, the stress concentrations present in the sharp square edge being elongated to form a female nodal flange.

105 The necessity for such a pickling step has been eliminated by our present invention because of the fact that the slit edge of the ribbon utilized to form the blank and the resultant core strip is no longer located in a zone of extreme elongation and the folded edge which is being elongated has a natural radius created by the fold.

The elimination of the significance of the work hardened edge of the ribbon utilized to form the core blank is particularly important in the case of titanium since the complicated annealing step in a vacuum furnace is eliminated.

120 It is, therefore, an object of our invention to provide a core strip blank characterized by the fact that the opposite edges of the blank are folded over to impart to the blank a doubler structure which provides on the edges of the blank a radius resulting from the method of creating the folded edges and which disposes the
 125

initial, impaired slit edges of the initial strip from which the blank is formed inwardly of the new radius edge thereof.

5 An additional object of our invention is the provision of a blank of the aforementioned character wherein the inner edges of the folded or doubler portions of the blank are welded to the contiguous portion of the blank to secure them in operative relationship therewith.

10 A further object of our invention is the provision of a core strip fabricated from the aforementioned blank in which the doubler edges are bent over to provide a continuous channel defined by said bent or folded over edges and the remaining web of the blank. By bending or folding 15 the doubled edge portions of the blank, a relatively thick and massive flange is provided which can be secured in operative relationship with the inner surfaces of the face sheets of a panel as by welding, diffusion bonding, brazing, 20 adhesives or the like.

By utilizing the core strip of our invention, a relatively thick flange is provided on the opposite edges of the core strip as constituted by the 25 folded over or doubler portion of the core strip. This greatly enhances the physical performance of the joint between the core strip and the surface sheets in flatwise tension, flatwise tension fatigue, and core shear fatigue.

30 An additional object of our invention is the provision of a core strip of the aforementioned character wherein subsequent deformation of the core strip results in the corrugated configuration and alternate male and female nodes described in 35 the aforementioned Campbell U.S. Letters Patent. When a plurality of such core strips are operatively interrelated with each other by cooperative relationship of the male and female nodes in the manner described in said patents, 40 the structural strength of a resultant panel which consists of a face sheet or face sheets welded or otherwise secured to the doubler edges of the core strips is greatly enhanced because of the fact that there are triple layers of material provided 45 where the flanges engage the face sheets and quintuple layers of material provided at the interrelated male and female nodes of the core strips and overlying face sheets. The resultant construction is characterized by substantially 50 greater resistance to flatwise tension than the structures described in the aforementioned patents.

As previously mentioned, it is contemplated that alternative embodiments of the core strip of 55 our invention be provided so that requisite physical characteristics may be achieved. For instance, in some applications, where the core strips are of corrugated configuration, openings or notches may be formed in the core strip at the 60 nodal portions thereof to facilitate the achievement of the corrugated configuration of the core strip without the massive deformation entailed by the provision of male and female nodes on the core strip as previously discussed.

65 In prior art constructions where such openings

or notches are provided at the nodal areas of the flanges, the resultant elimination of the flange continuum greatly reduces the performance of the resultant panel in flatwise tension by as much as 70 15 or 20%. However, by the utilization of the core strip of our invention the reduction of performance of the resultant panel in flatwise tension does not occur because of the fact that the doublers on the opposite edges of the core strip increase the performance of the resultant 75 panel to an extent which more than obviates the effect of the notches at the nodal areas of the core strips.

The formation of the openings or notches can be achieved prior to the formation of the core strip 80 into the channel-shaped configuration or subsequently thereto. For instance, the initial strip of material from which the blank is formed may be provided with circular openings adjacent the edges thereof prior to folding said edges to 85 achieve the doubler effect.

When the edges are so folded, the circular openings are reduced to form semi-circular notches in the doubled edges which notches 90 serve, in a manner to be described in greater detail hereinbelow, to facilitate the formation of the core strips into the desired corrugated configuration.

One of the advantages of the formation of the 95 notches in the above described manner is that the circular openings can be fabricated by the utilization of sturdy, punch-type tooling which is longer lasting and more accurate than the tooling customarily used in the clipping operation 100 entailed when the notches are formed in the edges of the doubler portion of the core strip blank after said doublers are formed.

Also within the scope of our invention are the various method steps utilized in fabricating the 105 core strip blanks and core strips described hereinabove. It is, therefore, an object of our invention to provide a method of fabricating core strip blanks which includes a first folding step whereby the opposite edges of a strip of suitable 110 material, such as stainless steel, titanium, or the like, are folded inwardly toward the center of the strip of material to provide doublers at the opposite edges of the strip of material.

Another object of our invention is the provision 115 of core strip blanks having rows of notches in the opposite edges thereof by the steps of forming elongated lines of openings in parallelism adjacent said edges in suitable strips of material and subsequently reducing the size of said 120 openings to provide notches in the edges of the resultant core blanks.

Another object of our invention is the provision 125 of the method of the aforementioned character wherein the subsequent reduction of the size of the openings to provide notches is accomplished by the first folding step whereby the doublers are provided on the opposite edges of the core strip blank, the folding step creating a fold on a line which intersects the continuous rows of openings 130 to provide said notches.

An additional object of our invention is the provision of a method of fabricating core strip blanks wherein the first folding step is accomplished by passing the strip of suitable material through a series of rollers whereby the doublers at the opposite edges have their inner surfaces engaging the contiguous portions of the blank and whereby a central web portion is permitted to remain between the edges of the doublers.

Another object of our invention is the method of forming a core strip which includes a first folding step for providing doublers on the opposite edges of a suitable strip of material and a second folding step whereby the doublers are folded angularly with respect to the intermediate web of the resultant core strip to provide a continuous channel between the continuous flanges constituted by said doublers.

An additional object of our invention is the provision of the aforementioned method wherein a subsequent step of deforming the channel-shaped core strip takes place to provide a corrugated configuration and alternate male and female nodes at the apices of said corrugations.

An additional object of our invention is the provision of a method of fabricating core strips which includes the steps of forming a continuous series of openings adjacent the opposite edges of a suitable strip of material; subjecting said strip of material to a first folding operation along a line located centrally of said openings to reduce the size of said openings and provide notches in the folded over portions of said strip; subjecting the resultant core strip blank to a second folding operation whereby the folded over edges are disposed in planes substantially normal to the plane of the centrally located web of the resulting core strip; and deforming said core strip into a desired configuration whereby the aforesaid notches are alternately reduced and expanded.

Also within the scope of our invention is the concept that, in the course of the first folding step, a bead may be formed at the folded edge of the doubler portions which is approximately one-third of to two times the thickness of the foil from which the core strip blank is formed. The bead prevents the edge fracture which might be caused by the first folding step and facilitates loading the core ribbons into the panel assembly fixture by providing a slight groove on the inwardly facing flange portions for reception of the core strip loading means, thus eliminating use of vacuum and/or force fits to maintain the core strip in proper position throughout the loading cycle of the core strip into the panel assembly apparatus.

Another object of our invention is the provision of a core strip which is characterized by the incorporation of the aforementioned doublers on the opposite flanges and which is also characterized by the provision of female and male nodes on alternate apices of the corrugations of the core strip. The core strip is further characterized by the fact that the flanges on the opposite edges of the strip are reduced to provide

the male nodes alternately on the strip and incorporate slots which facilitate the deformation of the flanges at the male nodes to eliminate irregularities therein due to the impact of the die in the deformation process.

A further object of our invention is the provision of a core strip blank which is characterized by the fact that alternate notches are provided in the opposite edges of the core strip blank which results in the aforementioned core strip so that the resultant notched and unnotched male and female nodes, respectively, are achieved.

It will, of course, be obvious to those skilled in the art that a wide variety of materials running the gamut from the simplest, such as paper, to the most sophisticated, exotic materials, such as titanium, can be utilized in applying the teachings of the invention as they relate both to product and method.

For instance, the teachings of previous Campbell patents, referred to hereinabove, have been applied to stainless steel and titanium and it is conceivable that the present teachings may be applied, in the future, to alloys which as yet have not been created.

Other objects and advantages of the invention will be rendered apparent from the accompanying drawings and the description of the invention hereinbelow.

Brief Description of the Drawings

Fig. 1 is an isometric view of a core strip blank upon which the first hole forming step of the method has been performed;

Fig. 2 shows the blank of Fig. 1 after the first folding step has been performed;

Fig. 3 is a view showing the formation of the core strip by the second folding step from the blanks of Figs. 1 and 2;

Fig. 4 is an isometric view showing a portion of the completed core strip after forming the strip into corrugated configuration;

Fig. 5 is a fragmentary isometric view showing a portion of an alternative form of core strip blank;

Fig. 6 is a view similar to Fig. 2 showing the modified core strip blank of Figure 5;

Fig. 7 is a view similar to Fig. 3 showing a core strip formed from the blank of Fig. 5;

Fig. 8 is an isometric fragmentary view similar to Fig. 4 but showing the completed core strip from the blank of Fig. 5;

Fig. 9 is a view showing an alternative form of core strip blank;

Fig. 10 is an enlarged fragmentary view taken on the line 10 of Fig. 3;

Fig. 11 is a view showing an alternative method of notch formation;

Fig. 12 is an isometric view showing an alternative form of core blank and core strip;

Fig. 13 is an isometric view showing the mating of the core strips of Fig. 12; and

Fig. 14 is a vertical sectional view taken on the broken line 14—14 of Fig. 13.

Description of the Illustrated Embodiments

Referring to the drawings, and particularly, to Figs. 1—4 thereof, we show a core strip blank 10 having a plurality of circular openings 12 formed therein adjacent the edges thereof, said circular openings being arranged in a straight line and being spaced inwardly of the edges 14 of the blank to facilitate the performance of the additional steps of the method.

The size and shape of the openings 12 are, of course, variable since it is conceivable that openings which are arcuately formed but are for instance, elliptical, may be provided in substitution for the openings 12. In addition, the edge distance between the outer perimeters of the openings 12 and the edges 14 of the strip blank 10 can be varied to space the outer perimeters of the openings 12 desired distances from the edges 14 of the blank.

Since the perimeters of the openings 12 are continuous, they can be formed by the utilization of one or more conventional punches which, because of the fact that they are piercing on their entire periphery, are extremely durable and which can be maintained in optimum condition with a minimum of maintenance effort.

Of course, notches can be formed in the opposite edges of the doubler flanges of the core strip blank, by clipping or other techniques, if desired. However, the ultimate function of the notches is identical, that is, to facilitate the formation of the core strip into its corrugated configuration.

The material from which the core strip blank 10 is fabricated can be stainless steel whose dimensions may range in an order from .002" to .005-4. It can also be fabricated from various titanium alloys for high performance aircraft or aerospace applications.

In commercial applications, various types of straight chromium or carbon steel sheet may be utilized in substitution for the more exotic stainless steel and titanium alloys.

Because of the utilization of various steps of the method of fabricating the core strip blank from core stock, the blank material can be purchased slit to a desired width. The usual tolerance employed is about $\pm .001$ per inch of width. Consequently, the expensive precision slitting of the core stock required in fabricating the strip of the Campbell patents is eliminated.

After the formation of the openings 12 by punching them in a continuous straight line in spaced relationship with each other and with the contiguous edges of the core strip blank, the core strip blank 10 is subjected to a first folding step which results in the provision of folded edges 16 to provide doublers, which simultaneously reduces the dimensions of the openings 12 to provide semi-circular notches 18 in the opposite edges of the blank 10. During the performance of the first folding step to which the blank 10 is subjected, a slight bead 20 may be formed at the edge of the fold which results in a continuous opening 22 encompassed by the bead 20.

The formation of the bead 20 eliminates the possibility that the edges of the folded over portions might be fractured when materials are utilized which are subject to excessive hardening or embrittlement.

Where more ductile materials are utilized, the bead 20 can be eliminated and a full contact fold can result from the first folding step.

Subsequently, the blank 10 is subjected to a second step, as best shown in Fig. 3 of the drawings, wherein the folded edges or doublers are subjected to a second folding or bending step which disposes the folded edges into planes substantially normal to the vertically disposed intermediate portion of web 26.

Furthermore, the inner edges of the doublers overlie the web 26, as at 23, Fig. 3. They may be secured to the web by a series of welds 90, Fig. 2.

Folded edges 16, which form doublers, may be sized so that the inner edge of the doubler lies at the juncture of the flange and web wall and does not overlie the web wall. In this construction, the doubler would be welded to the primary flange rather than the web wall, if it were desirable to weld down the doubler.

Thereafter, the blank 10 of Fig. 3 can be formed by a subsequent step into the core strip 30 of Fig. 4 by imparting the sinuous or corrugated configuration to the core strip 30, the semi-circular notches 18 at the male nodes 32 of the core strip will be substantially closed with the exception of a relatively small orifice 34.

Portions of the male nodes 32 are deformed to permit them to be fitted within the corresponding female nodes 36. The provision of the notches 18 facilitates the deformation since there is no longer an excess of material encountered which impairs the surface of the deformed portions.

Of course, the notches 18 at the female nodes 36 are substantially expanded to permit the undeformed and unreduced portions of the male nodes 32 to be juxtaposed thereto.

Therefore, despite the presence of the notches 18 there is a substantial structural continuum in the flanges provided by the doubled edges 16.

An alternative configuration of the core strip blank is illustrated at 40 in Fig. 5 of the drawings as having a plurality of relatively square or rectangular openings 42 formed in the blank 40 in the same manner and relationship as the circular openings 12 of the blank 10. The blank 40 is subjected to the initial folding step which results in the corresponding folds or doublers 44 and the reduction of the dimensions of the rectangular or square openings 42 to provide V-shaped notches 46 in the edges of the blank 40. The bead 48 is also provided having the minuscule bore 50 provided therein to eliminate cracking of work hardened material.

Subsequently, the second folding or bending operation or step is imposed upon the blank 40, which results in the disposition of the folded edges in a plane substantially normal to the plane of the central portion 52 of the blank 40. The

notches 46 are then disposed in a horizontal attitude.

The final step entailed in corrugating the blank results in the finished core strip similar to Fig. 8, wherein complete closure of the notches 46 occurs at the apices 64 of the corrugated strip 60, and substantial opening of the notches 46 occurs at the bases 62 of the corrugations to result in the male aspect of the apices 64 and the female aspect of the notches 46 at the bases 62 of the corrugations.

Although the formation of three configurations of openings, namely, circular, square or rectangular, has been disclosed, it will be obvious to those skilled in the art that various other configurations of openings can be utilized to impart the notch configuration to the opposite edges of the blank, and, ultimately, to the opposite edges of the core strip.

An enlarged detail is shown in Fig. 10 of the drawings to illustrate the formation of the bore or opening 22 by the formation of the bead 20 in the folded over portion of the blank 10.

Of course, there are known to the art core strips wherein a series of single layer, right angular folds or tabs are provided on the opposite edges of the corrugated strips, as in Johnson, supra. If such a core strip configuration is desired with a single layer of material at the opposite bent over edges, the sequence of method steps detailed hereinabove can be modified by eliminating the initial folding over step, and by cutting a blank 70 along longitudinal lines 72, Fig. 11, to provide notches in the edges into the blank prior to bending or folding over the edges into the substantially normal aspect previously described.

While there has been discussed hereinabove the concept of providing a plurality of blank strips for initial formation of the various shapes of openings which result in the ultimate notch configuration of the relevant core strips, a large sheet of core material, as shown in Fig. 9 of the drawings, and designated 80, can be utilized in which a plurality of lines 82 of openings can be formed by multiple punch operations, or the like. Subsequently, the large sheets of material, which can be constituted by a continuous, wide strip of core material fed from a roll of the same, can be slit to provide the blank configurations, such as those of Figs. 1 and 5, or configurations having the hole size and shape which are desired in the blank.

Consequently, it will be obvious to those skilled in the art that the formation of the core strip can result in the dual folded core strip of the character of the core strips 30 and 60 of Figs. 4 and 8, respectively, or can result in a core strip of the general configuration of that disclosed in the Johnson patent, supra.

It will also be obvious to those skilled in the art that the formation of the notches by initially punching openings contiguous to the edges of the blank or in continuous lines in larger blank stock, can be eliminated by the clipping technique adverted to hereinabove. Furthermore, the double

folding step results in the provision of triple layers of material at the interface of the double folds of the core strips, such as those of 30 and 60 of Figs. 4 and 8, respectively, with a panel face sheet imparting greater structural strength and shear resistance.

In order to eliminate the possibility that, despite the provision of the head 20 during the first folding step, a fracture might cause separation of the fold from the remainder of the blank, tack welds 90, as best shown in Fig. 2 of the drawings, can be provided which will ensure that the physical securement of the folded edges to the remainder of the blank will continue until the resultant core strip is securely fastened, by welding or other means, in operative relationship with an associated face sheet. It is desirable that the tack welds 90 be located in the portions of the folds which overlie the web 26 of the resultant core strip as best shown in Fig. 3 of the drawings, when the folds overlie the web wall.

As previously indicated, instead of fabricating the core strip blanks with previously formed holes or openings, as is the case with the above described embodiments and method steps of our invention, it is possible to fabricate the blank and resultant core strip with continuous flanges similar to those provided in the above mentioned Campbell patents. The flanges are deformed to provide the cooperative male and female nodes and to impart the corrugated configuration to the core strip by the use of suitable dies or other tooling.

Moreover, it is also feasible to provide notches in a previously fabricated continuous core strip flange by the clipping method which entails the use of dies which cut the notches in the previously formed folded edges of the core strip blank.

In addition to greatly enhancing the physical characteristics of panel utilizing the core strip having the doubler portions, the doubler portions provide numerous other advantages which eliminate many prior art operations encountered with such devices as are taught in the Campbell patents. For instance, during the slitting operation occasioned by the formation of the Campbell strip material prior to the fabrication of the core strip blanks, minute cracks are formed along the strip edge which tend to develop into major cracks during the formation of the female node due to the extreme elongation of the material occasioned by the fabrication of the female nodes which is of an order of 60% or more. The slitting also work hardens the slit edge increasing the tendency of the edge to crack during deformation.

Consequently, after slitting the core strips, they must be strand annealed or pack annealed. As mentioned previously, titanium core strip ribbon can be vacuum annealed to eliminate a portion of the micro-cracks.

By eliminating the annealing steps alluded to hereinabove, the first folding step and resultant doubler edge construction of the core strip considerably reduces the expense of fabricating

the core strip. This is due to the fact that the micro-cracks in the slit edge are disposed in overlying relationship with the web or contiguous area of the resultant core strip in locations where the elongation is negligible and the micro-cracks have no effect on the physical characteristics of the core strip and the resultant panel fabricated by the use thereof.

Another desirable result of the utilization of the folded or doubled edges is the fact that the rounded edges which must be provided by pickling and/or scarfing techniques on the slit edges of the prior art core strips can be eliminated since the provision of doublers on the edges of the core strip provides a rounded edge automatically and the sharp edges of the slit areas of the core strip are disposed in a zone of almost zero deformation when the corrugated configuration is imparted to the core strip.

While it is true that the doubled edge is work hardened and contains residual tensile stresses on its outer surfaces and residual compression stresses on its inner surfaces, these stresses are not additive to the massive elongation-produced tensile stresses caused when the core strip blank is deformed into the corrugated configuration. This is attributable to the fact that when the stresses are created they occur at ninety degrees to each other.

One of the most desirable physical characteristics achieved by the doubler edge construction of the core strip of our invention is that the flatwise tensile strength of the doubler flange is much greater than the prior art single flange construction.

Failure of the joint between the flange and the face sheet occurs at the edge of the weld resulting in shearing the core strip from the weld. Where a single layer flange is provided on the core strip, as in the prior art Campbell patents, the resistance to the shearing action is much less than the resistance of the doubler flange of the present invention due to the fact that the weld extends through two layers of flange material thus greatly increasing the strength of the weld joint.

Moreover, the resistance of the panel incorporating core strips having doubler flanges to flatwise tension fatigue and core shear fatigue is greatly increased because of the reinforcing effect provided by the doubler flange.

Tests have shown, by way of example and illustration, that with a single thickness conventional flange, using Inco 625 foil .003 thick, the force per spot weld required to tear the flange vertically from the face sheet is about 9 to 12 pounds. With the doubled core, and all else remaining the same, the force is from 15 to 20 pounds.

Alternative configurations of core strip blank and core strip are disclosed in Figs. 12—14 of the drawings wherein the core strip blank 102 is shown, Fig. 12, as being formed by a continuous die action into the core strip 104. The core strip blank 102 is characterized by the fact that notches 106 are formed in the doubled edges

108 of the blank by the clipping technique wherein the notches 106 are cut by punches in the doubled edges 108 after the formation of the doubled edges. In addition, the blank 102 is characterized by the fact that the notches 106 are spaced a greater distance apart than the continuous series of notches in the embodiments of the blank and core strip previously described so that notches 106 will only be found at alternate nodes of the resultant core strip 104 as described in greater detail hereinbelow.

The core strip 104 is of corrugated configuration and includes a web 110 having doubled flanges 112 on the opposite edges thereof. The core strip is provided with male nodes 114 and female nodes 116. The male nodes 114 incorporate the notches 106 which are reduced to a minute opening 118 during the deformation of the male nodes 114 to permit them to interfit with the female nodes 116 as best shown in Fig. 13 of the drawings. On the other hand, the female nodes 116 are not provided with notches but are merely permitted to assume the configuration shown in Figs. 12—14 of the drawings during the corrugating process.

The provision of the notches 106 at the male nodes 114 eliminates the ridges and irregularities which would occur if the notches 106 did not accommodate for the deformation of the material at the male nodes. Therefore, a better interfit between the male and female nodes 114 and 116 is accomplished.

The manner in which the male nodes 114 interfit at the female nodes 116 is shown in Figs. 13 and 14 of the drawings. The localized deformation of the male nodes 114 and the elimination of ridges at the point of localized deformation by the provision of the notches 106, facilitates the intimate engagement of the juxtaposed core strips 104. In addition, as best shown in Fig. 14, the interfit of the male and female nodes 114 and 116 provides four layers of material constituted by the doublers of the flanges 112 for the reception of a fifth layer of material constituted by the surface sheets, not shown, on each side of the panel in which the core is installed or constructed.

As previously indicated, the inner edges of the doublers overlie the web 26, as at 23, Fig. 3. While the inner edges of the doublers are shown as overlying a relatively small portion of the web, it is obvious that a greater length of material on the doublers will cause a greater overlying portion of each doubler to cover the web, if desired.

120 Claims

1. A core strip blank including an elongated body having doublers at the opposite edges thereof, said doublers being continuous and having a web therebetween.

2. The core strip blank of Claim 1 in which said doublers are constituted by integral folded over edge portions of said body.

3. A core strip blank including an elongated body, said body having double layers of material